VII. Fuels Treatment Implementation Strategy and Priorities

Fuels, weather, and topography determine fire behavior and especially fire intensity. Of these three, we are able to affect only the fuels element in modifying fire behavior and intensity. The implementation and mitigation portion of the CWPP will focus on fuel treatments that reduce stand densities and accumulated debris on the forest floor.

Crown fires are often considered the primary threat to the ecology of dry forest types and human values. However, even surface fires can damage soils, weaken or kill overstory trees, and provide an ignition source for homes and other property. Our current understanding of fire behavior in dry forests dominated by ponderosa pine and Douglas fir indicates that a crown fire begins with a transition from a surface fire to the ignition of the canopy. Crown fires are therefore dependent upon the sequence of available fuels (first surface fuels-woody fuel, low vegetation and shrub strata, then ladder fuels, then canopy fuels). Fuel management in forest stands can be designed to target specific fuel strata and disrupt the vertical progression of fire from surface fuels to ladder fuels to canopy fuels, and the horizontal progression of fire through individual strata, especially from crown to crown. Research has shown that the most effective strategy for reducing crown fire occurrence and severity is to (1) reduce surface fuels, (2) increase height to live crown, (3) reduce ladder fuels and canopy bulk density, and (4) reduce continuity of the forest canopy. The overall objective of the Greater Williams Area CWPP treatments is to reduce the likelihood of crown fire and other fire behavior that would lead to a loss in value, lead to undesirable future conditions, or threaten lives and destroy homes.

The specific goals of the greater Williams area CWPP implementation plan are:

- Fuel treatments will provide for both firefighter and public safety during wildfire suppression emergencies.
- Fuel treatments will greatly reduce the potential of a high intensity crown fire from entering communities and destroying property.
- Fuel treatments will provide areas where fire suppression efforts can be effective and destructive wildfires are contained at a minimal size.
- Fuel treatments will provide areas where conditions exist that allow for prescribed fire and wildland fire use with little threat to communities.
- Fuel treatments will be based upon the best available science and multi-party monitoring that leads to adaptive management and flexibility in future fuels treatment planning and implementation.
- Fuel treatments will contribute toward restoration of healthy sustainable ecosystems that are resistant to natural disturbances such as drought, insects and wildfire.
- Fuel treatments will begin returning the entire WUI area back to a fire regime condition class 1, where fire can play a natural role in maintaining healthy, sustainable, and resilient ecosystems.

Implementation strategies are outlined here as treatment options available for all agencies and jurisdictional ownerships. These implementation strategies and treatment options are based on the USDA Forest Service General Technical Report *Science Basis for Changing Forest Structure*

to Modify Wildfire Behavior and Severity, RMRS-GTR-120, Dr. Russell T. Graham, et al (April 2004). The following is the abstract from this report.

> *Fire, other disturbances, physical setting, weather, and climate shape the structure and function of forests throughout the Western United States. More than 80 years of fire research have shown that physical setting, fuels, and weather combine to determine wildfire intensity and severity. Millions of acres of forestlands (mainly in dry forests dominated by ponderosa pine and/or Douglas fir) contain a high accumulation of flammable fuels compared to conditions prior to the 20th century. Forests with high stem density and fuel loading combined with extreme fire weather conditions have led to severe and large wildfires (such as those seen in the summers of 2000, 2002, and 2003) that have put a number of important values at risk. Although homes in the path of a wildfire are perhaps the most immediately recognized value, these wildfires also put numerous other human and ecological values at risk, such as power grids, drinking water supplies, firefighter safety, critical habitat, soil productivity, and air quality.*
>
> *For a given set of weather conditions, fire behavior is strongly influenced by stand and fuel structure. Crown fires in the dry forest types represent an increasing challenge for fire management as well as a general threat to the ecology of these forests and the closely associated human values. Crown fires are dependent on the sequence of available fuels starting from the ground surface to the canopy. Limiting crown fire in these forests can be accomplished by actions that manage in concert the surface, ladder, and crown fuels. Reducing crown fire and wildfire growth across landscapes decreases the chances of developing large wildfires that affect human values adjacent to forested areas.*
>
> *Fuel treatments can help produce forest structures and fuel characteristics that then reduce the likelihood that wildfires will cause large, rapid changes in biophysical conditions. Fuel treatments can also help modify fire behavior sufficiently so that some wildfires can be suppressed more easily. Subsequent sustained fuel treatments can maintain these conditions. Different fuel reduction methods target different components of the fuel bed. Thinning mainly affects standing vegetation, and other types of fuel treatments such as prescribed fire and pile burning woody fuels are needed to modify the combustion environment of surface fuels. In forests that have not experienced fire for many decades, multiple fuel treatments – that is, thinning and surface fuel reduction – may be required to significantly affect crown fire and surface fire hazard. Fuel treatments cannot guarantee benign fire behavior but can reduce the probability that extreme fire behavior will occur. Fuel treatments can be designed to restore forest conditions to a more resilient and resistant condition than now exists in many forests and subsequent management could maintain these conditions, particularly in dry forests (ponderosa pine and Douglas fir) where crown fires were historically infrequent. The degree of risk reduction will depend to some degree on the level of investment, social and economic acceptability of treatments, and concurrent consideration of other resource values.*

The report describes the available scientific knowledge for making informed decisions on fuel treatments used to modify wildfire behavior and effects in dry forests of the interior Western United States (especially forests dominated by ponderosa pine and Douglas fir). As stated above, this report is perfectly suited for describing treatment options within the greater Williams area WUI and is the basis for all CWPP fuels treatment options.

A. Fuels Treatment Options

In forests that have not experienced fire for many decades, multiple fuel treatments are often required to achieve the desired fuel conditions. Thinning followed by prescribed fire reduces canopy, ladder, and surface fuels, thereby providing maximum protection from severe fires in the future. Potential fire intensity and severity in thinned stands are significantly reduced only if thinnings are accompanied by a reduction in the surface fuels created from the thinning operation. The following describes each treatment option individually, recognizing that most areas will require a combination of two or more treatments as well as periodic maintenance to accomplish the overriding goal of reducing the likelihood of crown fires within the WUI.

1. Thinning

Thinning is the silvicultural practice of removing selected trees in a stand to reduce competition for light, water, and nutrients and thereby promote the growth and survival of the remaining trees. Thinnings can range from full ecological restoration treatments leaving only 25-40 large diameter trees to less intensive treatments as described below.

Full restoration thinnings are used to restore forest structure to the approximate condition at the time of disruption of the natural fire regime. This entails recreating, as much as possible, the density, spatial distribution, and natural variability of living trees of all species that were present prior to fire exclusion beginning in approximately 1870. The goal of full restoration treatments would be reached through thinning and prescribed burning. The objective of full restoration treatment is to remove most of the post settlement trees, allowing for replacement trees for presettlement tree mortality, and produce an uneven aged stand where trees are grouped in clumps and are vibrant, healthy, resilient, and resistant to natural disturbances such as drought, bug infestation, and wildfires. Full restoration thinning is considered the most aggressive thinning treatment in use today.

Intermediate thinnings are generally called “thinnings from below” and typically remove the small and intermediate sized trees to provide openings and reduce ladder fuels. Presettlement trees are protected as well as some of the larger post settlement trees. Thinnings are used to create openings, leaving uneven aged stands in clumps in a mosaic fashion.

Low intensity thinnings are those that generally only remove the smaller diameter trees (less than 9” in diameter) but could include sizes up to 16 inches to meet crown fire risk reduction goals.

Planning for site specific projects should include options that incorporate restoration principles. Planning should also address the timing and methods of thinning operations to minimize the risk of insect and disease infestations.

Any of the thinning treatments can offer some commercial value of the trees that are cut. The sale of wood products from our overgrown forests is encouraged to help off-set the costs of treatments.

Cost estimates for thinning assume that only trees up to 16 inches in diameter would be cut by the agencies or private landowners. Trees larger than 16 inches are assumed to have commercial value therefore would not cost the agencies or landowners for removal and the value of the timber could offset other fuels treatment work.

The desired future condition of any of the thinning treatments is to create forest conditions, across the landscape, where the likelihood of a catastrophic crown fire will not occur and threaten lives and property. In general, forest stands will consist of 25 to 100 larger diameter trees per acre or a basal area ranging between 30 and 80 per acre. Trees of all sizes are found in clumps with openings interspersed with abundant herbaceous vegetation.

Basal area is defined as the cross section area of tree stems in square feet commonly measured at breast height (4.5' above ground). The basal area factor is the number of square feet of basal area of all trees on a given acre of land. Forty basal area equals 40 square feet of cross sectioned tree stems on one acre.

Thinning dog hair thicket. Source: Kaibab National Forest

Thinned to 30 basal area, slash not yet treated. Source: Kaibab National Forest

Recent thinned, piled, and burned treatment area. Source: G. Kleindienst

Thinning a forest stand without the removal or treatment of the slash, often creates a greater fire hazard than prior to the thinning. The following describes the various treatments for dealing with thinning slash.

2. Hand Piling

Hand piling is simply the manual piling of slash to be burned under moist or wet conditions. Hand piles are generally small compared to mechanical piles and are usually only six feet high and 6-8 feet in diameter. Hand piles are located in openings to minimize scorching and mortality of nearby trees when burned. Hand piling is labor intensive and therefore costly but is a necessary tool when other factors prevent a different slash treatment (such as slope steepness).

Hand piles in thinned area. Source: G. Kleindienst

3. Machine Piling

Machine piling is widely used and is done with bulldozers and skidders to pile slash for later burning. Machine piling is appropriate on flatter terrain, stable soils, and in more open areas where other factors, such as cultural resource concerns, are not an issue. Machine piles are generally larger than hand piles and can be 12 feet high and cover large areas. The size of the piles is determined by the size of the openings to minimize scorch and mortality.

Both methods of piling, hand and machine, are extensively used in treatment areas with high fuel loads to more safely treat the large volume of slash. Piling is also the most common slash treatment adjacent to homes and private property.

Dozer piling. Source: Kaibab National Forest

4. Lop and Scatter/Crushing

Lop and scatter slash treatment is utilized in those areas where the fuel load is less and therefore safe to lop and scatter the slash for later treatment in a prescribed broadcast burn. This method generally calls for thinned trees to be limbed and cut to lay within 12-24 inches off the ground and dispersed to prevent fuel concentrations.

Mechanically crushing slash has the same objective where bulldozers are used to crush the slash down to the ground. Crushing is less labor intensive and can be used where other natural resource issues are not a concern for mechanized equipment.

Un-lopped thinning slash. Source: Kaibab National Forest

5. Chipping

Although occasionally used, this technique is comparatively expensive and chips decompose slowly in our area. If later broadcast burning is anticipated, chips may add to smoke management concerns. Chipping can be used effectively around private land where the homeowner uses the chips for mulch or landscaping. Hauling chips from a site is very expensive.

6. Pile burning

Pile burning is done under moist or wet conditions. The goal of pile burning is to consume 80-100% of the piled material while minimizing the scorch and mortality of the residual stand. Ignition is generally accomplished by hand using drip torches. Pile burning may be the final treatment or it may serve to remove excess slash in preparation for a later broadcast burn.

Pile burning in snow. Source: Kaibab National Forest

7. Broadcast Burning

Broadcast burning is defined as the skillful application of fire on a landscape to intentionally burn forest fuels. Burning is conducted under prescribed conditions specified in an approved plan to meet management objectives and confined to a predetermined area. Broadcast burning generally calls for flame lengths of less than 4 feet but some prescriptions may call for greater flame lengths to raise crown heights or thin with fire. Ignition can be by hand with drip torches, by mechanized means using all terrain vehicles, or aerially, using helicopters and a plastic sphere dispensing machine.

Ignition of broadcast burn unit. Source: Kaibab National Forest

Patrolling lines of broadcast burn. Source: Kaibab National Forest

8. Various Combinations

Multiple treatments in a given area are often needed to effectively treat an area and minimize crown fire potential. This is even truer the closer the treatment area is to homes, buildings, or infrastructure needing protection. Full restoration thinning, followed by slash piling and burning, with a final broadcast burn of the site offers the greatest protection and highest likelihood that a crown fire will not threaten structures. The objective of fuels treatments within the WUI is to treat the entire fuel strata. Thinning reduces stand density, ladder fuels, crown bulk density, and reduces the continuity of the forest canopy. Pile burning and broadcast burning reduces the surface

fuel load and can increase the height to live crown. Generally a combination of treatments is required to meet the fuels treatment objectives.

9. Maintenance of Treatments

Maintenance of treated areas is often overlooked, as initial entry fuels treatments are the priority. Within the RMRS-GTR-120 report, research is cited that examined the effectiveness of treatments over time. In general, in the dry forest types of the greater Williams area, treatment effectiveness lasts only 7-15 years. Depending upon the initial treatment, maintenance usually only requires a second entry broadcast burn which is typically less complex than the first entry burn. However, if the initial treatment was low intensity or included no thinning, additional thinning may be required. Maintenance of existing treated areas within the WUI is recommended every 10 years.

Low intensity burn in open stand. Source: Kaibab National Forest

B. Fuels Treatment Benefits

The following two maps (Maps 10 and 11) are used to display the tremendous benefits of fuels treatments. The first map is a crown fire risk assessment using the same methodology as before. However, through the Forest Vegetation Simulator, we have applied a thinning treatment down to 40 basal area. The slash was piled and then burned. The INFORMS burn model then re-determined the torching and crowning index across the area. The original crown fire risk map is included again for easy comparison of the results.

One anomaly occurred during this process in the pinyon-juniper woodlands. Thinning the PJ this much in the simulation resulted in a fuel type conversion where grasses and shrubs dominate the

area. This changed many areas from a moderate risk to an extreme risk where the burn model predicts the shrubs being completely consumed and therefore at "extreme" risk.

Currently, nearly 60% of the identified wildland urban interface is in the extreme or high risk category for potential crown fire. After thinning, piling, and burning, the areas with extreme or high risk for crown fire are reduced to 11**%** of the WUI area. A large portion of this 11% is in the pinyon-juniper areas due to the fuel type conversion in the simulation so a more accurate estimation of change in the timbered area is less than 5% at high or extreme risk. The map information table in Appendix 2 shows the changes in the relative risk rating after treatment. Extreme and high risk areas are reduced by 152,984 acres.

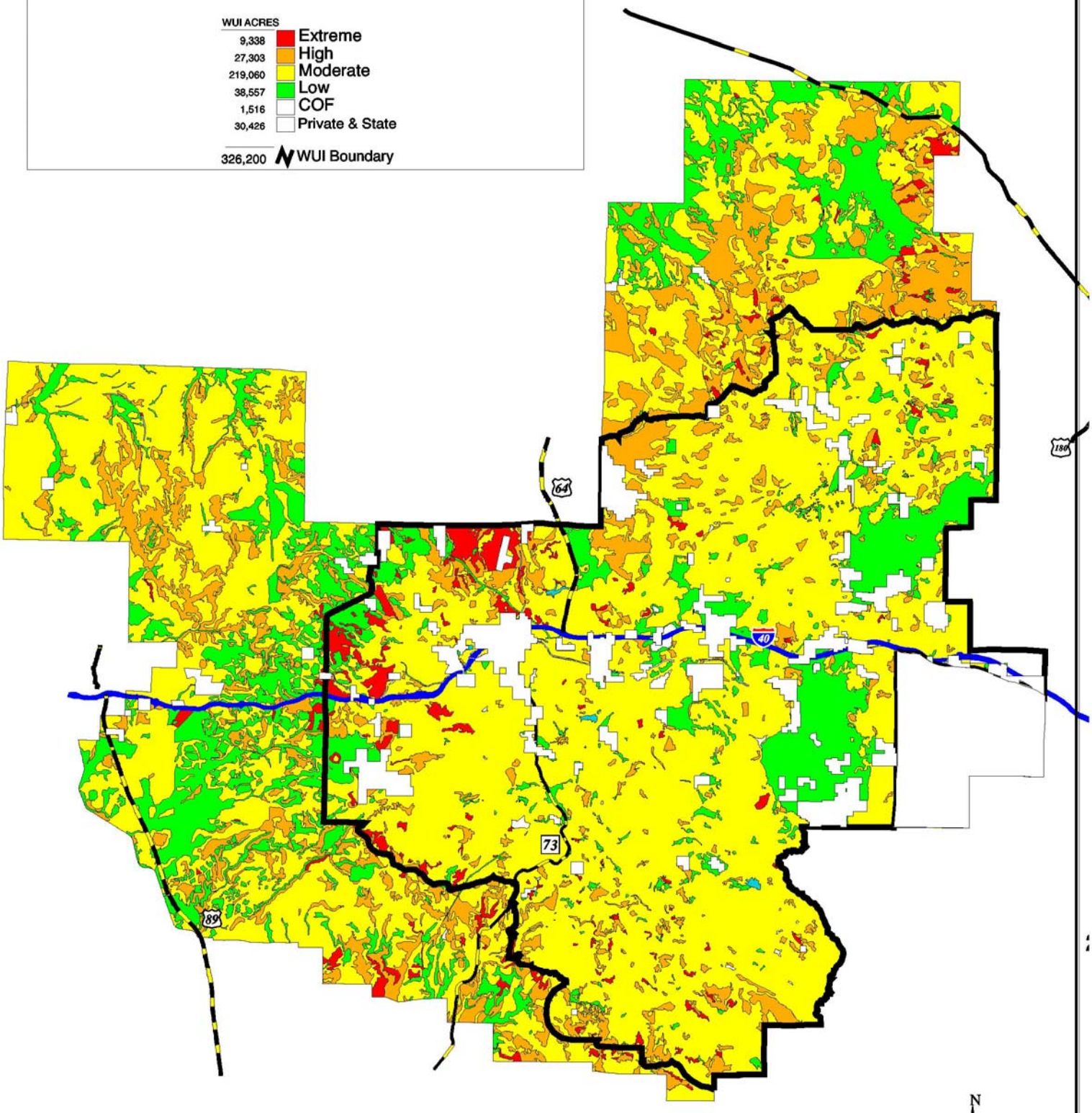
Pumpkin fire four years later. Source: G. Kleindienst

Pumpkin fire erosion, July 2000. Source: Kaibab National Forest

CROWN FIRE RISK AFTER SIMULATED 40 BA THINNING & BURNING

Map 10

Kaibab National Forest
Williams Ranger District
Coconino County



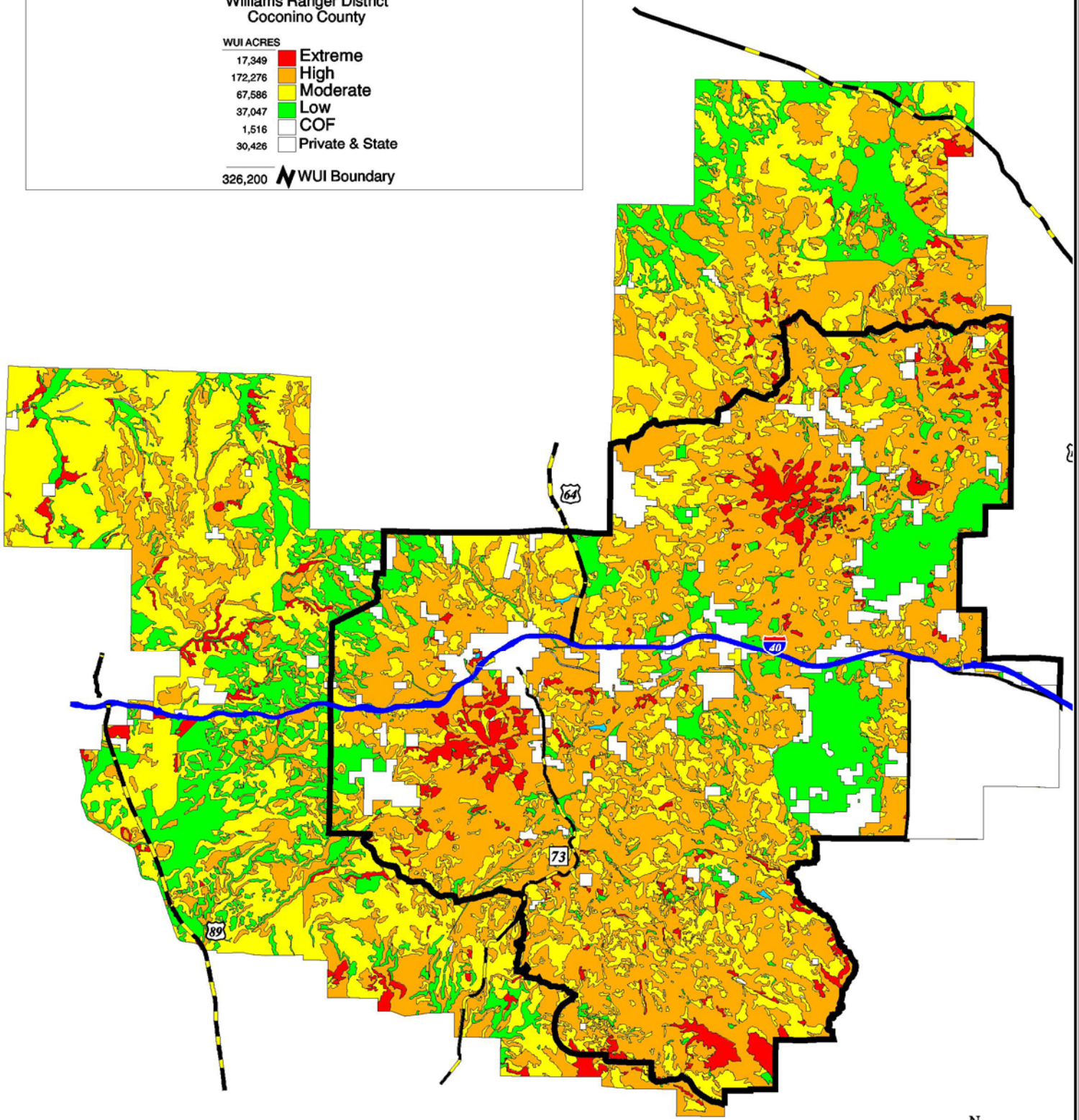
TGMc January 2005
/trifles/wui/williams/utm/5150_fuel_mgt/crwpp_gbloincforest Crown Fire Risk after Thinning to 40 BA

CROWN FIRE RISK ASSESSMENT & WUI BOUNDARY

Kaibab National Forest
Williams Ranger District
Coconino County

Map 11

WUI ACRES	
17,349	Extreme
172,276	High
67,586	Moderate
37,047	Low
1,516	COF
30,426	Private & State
326,200	WUI Boundary



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TGMc November 2004
/fsfiles/unit/williams/afm/5150_fuel_mgt/cwpp_gkleindienst Crown Fire Risk